

# Workshop on Advances in Multidisciplinary Turbomachinery Design Optimization and Combustion for Micro Gas Turbines

**Date:** Tuesday, November 3<sup>rd</sup>, 2015    **Location:** Aerospace Faculty Auditorium  
**Time:** 08:30-17:00

The training activities will be open for all students, industry and academic staff. There is no cost for registration; however it is mandatory for all participants. Please reserve your spot until 20/10/2015 by contacting Vered Seginer <[veredseg@ae.technion.ac.il](mailto:veredseg@ae.technion.ac.il)>.

## Program

- ❖ 08:30 - 08:45 Registration and Introduction
  
  - ❖ 08:45 - 09:30 Introduction to multidisciplinary design optimization for turbomachinery  
o Single objective and multi objective optimization problems  
o Parametrization, evaluation, treatment of multiple objectives and constraints
- Prof. Tom Verstraete
- ❖ 09:30 - 11:00 Zero and first order Optimization methods
    - o Evolutionary Algorithms
    - o Particle Swarm Optimization
    - o Acceleration of zero order methods by metamodels
    - o Gradient based optimization: basic concept of adjoint optimization
  - ❖ 11:00 - 11:20 Coffee Break
  - ❖ 11:20 - 12:30 Application of optimization techniques to micro turbomachinery design
    - o Radial compressors
    - o Axial compressors
    - o Axial turbines
    - o Internal cooling channels
  - ❖ 12:30 - 13:30 Break (Light Lunch will be served)
- Dr. Michael Klassen
- ❖ 13:30 – 14:30 Introduction to Combustion and Combustion Chemistry
    - o Fuel effects,
    - o Size effects
    - o Gas turbine operability issues
  - ❖ 14:30 – 15:30 Pollution Formation in Gas Turbines
    - o Nitric oxides
    - o Carbon monoxide
    - o Particulates
    - o Design considerations for minimizing emissions and operational stability in micro gas turbines
  - ❖ 15:30 - 15:50 Coffee Break

- ❖ 15:50 – 17:00 Chemistry Modeling Techniques for Combustor Design
  - Mechanism development- Full and reduced mechanism development techniques
  - Reactor network modeling – Fundamentals and application to gas turbines
  - CFD - Use of chemical mechanisms, Examples

### **Bio:**

#### Prof. Tom Verstraete

Dr. Tom Verstraete is currently a visiting professor at Queen Mary University of London after obtaining a Marie-Curie Individual Fellowship. He is an adjunct professor at the Von Karman Institute for Fluid Dynamics and has over 11 years of experience in the design of various turbomachinery components, ranging from axial/radial compressors/turbines, internal cooling channels to space propulsion inducers, nuclear pumps, and steam turbines diffusers. He has authored or co-authored over 90 journal papers, conference papers and contributions to books. His research interests comprise multidisciplinary shape optimization, conjugate heat transfer and micro gas turbines.

#### Dr. Michael Klassen

Dr. Klassen is currently a Principal Research Engineer and founding partner at Combustion Science & Engineering, Inc (CSE). He is also Chief Technical Officer of LPP Combustion, a company which is developing new techniques for the clean combustion of liquid fuels. During his tenure at CSE, he has been involved in a diverse range of experimental and analytical engineering projects, including the design, development and implementation of both small- and large-scale fire tests and combustion studies; chemical kinetic studies of processes such as ignition, extinction and flame holding in various combustion systems; and fuel/air mixing studies in a variety of combustion systems. He has directed projects involving the development of novel combustion systems, including applications at extreme temperatures and pressures, oxygen/ fuel combustion, and lean, premixed, prevaporized liquid fuels systems. He holds numerous patents on novel combustion methods and hardware and for fire safety devices. He has authored or co-authored dozens of journal papers and conference papers.